of music. However, her pulse measurements indicated that she was having an autonomic response even before being exposed to the epileptogenic music.

Because our experimental fMRI design was inherently sensitive to the effect of prolonged listening to music (control followed by epileptogenic music), the observed activity changes in the fronto-orbital lobes may have reflected emotional arousal and memory related to the music[1,2] rather than seizure activity per se. Our findings suggest that during the patient's aura, the main differential evoked activity was localized in the rGR. Nevertheless, the control music may have contributed to the enhancement of the patient's susceptibility to the ensuing seizure-inducing music, possibly in the form of progressive cortical recruitment.[2] Indeed, the large negative activations that surrounded the rGR in the epileptogenic music conditions may indicate uncompensated hypermetabolism or vascular dysregulation.[10]

Even within the relatively short time frame of the fMRI study, the ability of the same stimulus to evoke an epileptic aura varied. The imminent exposure to the feared stimulus and the foreign atmosphere of an fMRI experiment may have contributed to the failure to induce epileptic aurae in the first three exposures, whereas the results for the final two sessions are suggestive of habituation to the repeated stimulus presentation.[1,2] A similar habituation was found for the signal in the rGR during the aura sessions although a clear-cut correlation with the button press latencies was not evident.

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Trends in dementia mortality from two National Mortality Followback Surveys

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Abstract—The National Center for Health Statistics conducted National Mortality Followback Surveys (NMFS) in 1986 and 1993. The next-of-kin's report of a physician's diagnosis of AD before death and a listing of AD or other dementia as the underlying cause increased significantly among women but remained stable among men. Currently, AD is among the top 10 leading causes of death in elderly white men and women in the United States.

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As the US population ages, mortality from dementia is likely to increase concomitantly due to the well-known association between incidence of dementia-related diseases and aging.[1,2] Planning for future health care services, especially long-term care, is served by knowledge of trends in dementia mortality. The National Center for Health Statistics (NCHS) provided data for an initial examination of national estimates of dementia mortality in the 1986 National Mortality Followback Survey (NMFS).[2] Although death certificate data are known to seriously underestimate the presence of dementia,[2,3] the NMFS also provided rates based on next-of-kin interviews addressing the decedent's history of physician diagnoses and disabilities before death.

In 1993, the NCHS conducted a second NMFS.[4]

Table 1 *Age-adjusted* dementia mortality rates per 100,000 population age 65+ according to sex, by source of dementia diagnosis and survey year (NMFS: 1986 and 1993)*

Source and year	Male	Female
Underlying cause mortality		
1986	47.6 (33.5, 61.7)	46.3 (36.7, 55.9)†
1993	36.6 (32.9, 40.3)	73.5 (69.6, 77.4)
Multiple cause mortality		
1986	118.5 (96.4, 140.6)	131.7 (116.4, 147.0)†
1993	158.0 (116.3, 199.7)	196.1 (161.8, 230.4)
Informant interview‡		
1986	661.7 (610.5, 712.9)	745.6 (710.5, 780.7)†
1993	668.3 (592.6, 744.0)	898.1 (824.4, 971.8)

Values are rate (95% CI).

* Direct age adjustment to 1990 census standard population.

† $p < 0.05$ For pairwise comparison (two-tailed) between 1986 and 1993 rates.

‡ Informant reported a physician diagnosis of dementia.

NMFS = National Mortality Followback Survey.

We present nationally representative estimates of mortality rates due to dementia among persons aged 65 years and older for both the 1986 and the 1993 NMFS. In addition, we assess trends in the prevalence of physical disability among persons with dementia, based on their need for help with activities of daily living (ADL) in the last year of life.

Methods. The 1986 and 1993 NMFS were designed to supplement the information available from death certificates. They were based on nationally representative, stratified 1% probability samples of death certificates of persons who died during the respective survey years. The studies excluded deaths from Oregon for both years and South Dakota for 1993 because of those states' respondent consent requirements. Information about the decedent was obtained from questionnaires administered to the informant listed on the death certificate or another individual who was knowledgeable about the decedent's last days. Approximately 90% of the informants for the elderly decedents were close relatives (spouse, child, or sibling). Interviews were conducted by mail (1986) and telephone (1993), with some in-person interviews for persons who did not respond to the original contact. The final response rate for informants reporting on decedents age 65 and older was approximately 88%. A total of 6,657 elderly decedents from 1993 (53% women) and 8,770 from 1986 (53% women) with both death certificate and informant data were included in this analysis. In the 1993 NMFS, persons aged 100 and older at the time of death were oversampled to provide more reliable estimates of health status before death in this age group (n = 803).

Dementia diagnosis was ascertained in three ways: from the death certificate as the underlying cause of death, from multiple causes of death recorded on the death certificate, and from informant reports of a physician's diagnosis of AD or any other serious memory or orientation impairment during the decedent's lifetime. Physical functioning during the last year of life was determined by a series of questions regarding whether the decedent had difficulty with ADL (bathing, dressing, using the toilet, or eating). Problems with cognitive function in the last year of life were determined by questions concerning whether the decedent had difficulty in orientation as to place and time and difficulty recognizing family and close friends.

Data analyses were carried out using SUDAAN software to account for the design effects in the NMFS induced by the complexities of the sampling design.[5] Estimates of standardized mortality rates, population percentages, and other characteristics

Table 2 *Percent of demented persons with ADL disability and cognitive impairment in the last year of life by survey year, according to source of dementia diagnosis (NMFS: 1986 and 1993)*

	Source	
Disability or impairment	Multiple cause mortality (95% CI)	Informant interview (95% CI)
ADL disability*		
Bathing		
1986	94.0 (90.7, 97.3)	90.8 (89.0, 92.6)†
1993	88.3 (80.1, 96.5)	86.1 (82.0, 90.2)
Dressing		
1986	90.9 (86.6, 95.2)	86.5 (84.3, 88.7)
1993	83.5 (74.1, 92.9)	81.6 (76.9, 86.3)
Toilet		
1986	87.6 (82.7, 92.5)	83.8 (81.4, 86.1)†
1993	76.3 (65.5, 87.1)	74.4 (69.1, 79.7)
Eating		
1986	75.6 (69.3, 81.9)	72.6 (69.9, 75.3)†
1993	62.3 (49.6, 75.0)	60.6 (54.7, 66.5)
Cognitive impairment*		
Difficulty understating where he or she was all or most of the time		
1986	53.9 (46.8, 61.0)	42.1 (39.2, 45.0)
1993	60.8 (48.6, 73.0)	42.8 (36.7, 48.9)
Difficulty remembering the year all or most of the time		
1986	57.6 (50.5, 64.7)	51.6 (48.7, 54.5)
1993	65.3 (53.1, 77.5)	46.8 (40.7, 52.9)
Difficulty recognizing family and friends all or most of the time		
1986	36.3 (29.2, 43.4)	30.2 (27.5, 32.9)
1993	43.8 (30.9, 56.7)	33.3 (27.4, 39.2)

* From informant interview.

† $p < 0.05$ For pairwise comparison (two-tailed) between 1986 and 1993 rates.

ADL = activities of daily living; NMFS = National Mortality Followback Survey.

were fully weighted to be representative of the US population of elderly decedents in each respective year. t-Tests and confidence intervals were calculated to assess statistical significance of differences and variability in the survey estimates. Standardized mortality rates were computed by the direct method, using the 1990 Census as the standard population. All analyses were limited to decedents aged 65 and older.

Results. Approximately 74 women per 100,000 population age 65 and older died from AD or other dementia as the underlying cause in 1993 (table 1), a 60% increase in the cause-specific rate compared to the 1986 NMFS ($p < 0.01$). The 1993 dementia mor-
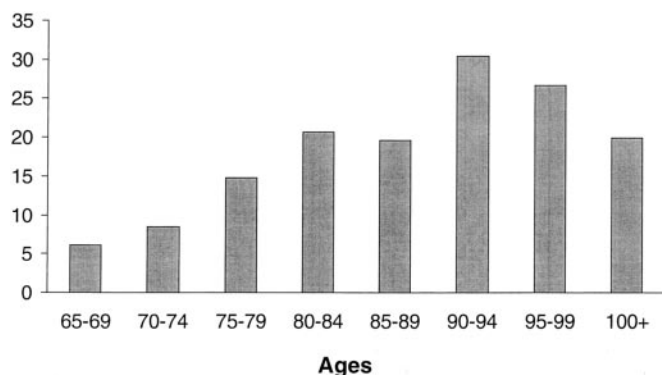
Figure. Percent of decedents with a lifetime history of dementia by age: National Mortality Followback Survey 1993.

tality rate among men (37 deaths per 100,000 persons) was not statistically different from the 1986 rate. The multiple-cause mortality rate increased about 48% for women between 1986 and 1993 ($p < 0.01$) and by a lesser amount of 33% among men ($p = 0.10$). Informant interview data showed that, in 1993, a physician's diagnosis of dementia preceded 668 male deaths per 100,000 population age 65 years and older compared with 898 female deaths per 100,000 population. Among women, this rate was 20% higher than in 1986 ($p < 0.01$); among men, the rate remained similar.

A vast majority of the decedents reportedly had difficulty in ADL during their last year of life according to next of kin, ranging from 60% requiring assistance in eating to nearly 90% needing assistance in bathing (table 2). Among those with an informant-reported physician's diagnosis of dementia, the prevalence of ADL disability declined significantly between 1986 and 1993 in bathing, toileting, and eating, suggesting less disability among the 1993 decedents with dementia. Similar declines in the prevalence of ADL disability were observed among decedents with dementia listed as one of the multiple causes of death. However, these declines did not reach significance because of the small number of decedents with dementia listed on the death certificate. In contrast, the prevalence of cognitive impairment indicated by next-of-kin reports of difficulty in orientation, memory, and recognition remained unchanged between surveys.

The overall percent of decedents with an informant report of a physician's diagnosis of AD or other dementia increased from 14% in 1986 to 17% in 1993 ($p < 0.05$), representing about a 20% increase in the lifetime prevalence of dementia. In 1993, the risk increased with age from about 7% among those 65 to 69 years of age at death to nearly 30% among those aged 90 to 94 years, and then declined to less than 25% in those aged 95 years and older and less than 20% among centenarians (see the figure).

Discussion. In 1993, about 17% of decedents aged 65 years and older had been diagnosed with AD or other cause of dementia by a physician before death. The age-specific rise and subsequent decline in the lifetime history of a physician's diagnosis of AD among the oldest decedents suggests that long-lived individuals may experience a lower lifetime risk for AD and other brain diseases. However, community-based studies of clinically diagnosed AD and other dementia are inconclusive with respect to trends in lifetime risk as some studies suggest a decline and others suggest no abatement in cumulative risk.[6,7]

Although the severity of the dementia was not known in these surveys, the fact that severity of dementia is associated with severity of ADL disability[8] and that the prevalence of ADL disability among patients declined between surveys together suggest an increase in diagnoses at earlier stages of the disease. Further study is warranted, however, as the reported prevalence of memory problems and difficulty in orientation and recognition from next of kin was similar between surveys.

Regardless of the source of ascertainment, mortality rates due to dementia among elderly women were higher in 1993 than in 1986. For men, the rates did not increase significantly. The increased reporting of AD diagnoses among women between surveys may be related to their greater use of nursing home care before death as nursing home admission may prompt recording of existing AD diagnoses that subsequently get listed on death certificates. In 1993, approximately 30% of deaths among women aged 65 years and older occurred in nursing homes, vs 20% among men. In addition, an increased awareness of the symptoms of AD in the general population and the importance of diagnosing dementia in clinical practice may have accounted for some of the trends. Currently, AD ranks as one of the 10 leading causes of death among white patients aged 65 years and older.[9] Advances in treatment and the specialized health care needs associated with AD warrant more careful assessment and reporting by health professionals in both medical and vital records.[10]

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